Determining Sources of Phosphorus Spikes in a Florida Everglades Estuary

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Introduction

This study was conducted in the southern mangrove ecotone region of Taylor Slough in Everglades National Park (Figure 1). Taylor River is located in this ecotone region between two FCE-LTER water quality monitoring stations and is characterized by a series of interconnected ponds and creeks (Figure 2). In this study we hope to determine the source of phosphorous concentration spikes which occur during periods of decreased freshwater flow and longer water residence times associated with the "dry" season.

During the wet season months from June to November, there is a distinct freshwater input on the mangrove estuary from the north. This freshwater pulse essentially "flushes" most of the river and lowers salinity to less than 1 ppt. However, during dry months from December to May, water residence times increase dramatically and salinity can increase to near 50 ppt..

A 3 km pond vs. creek transect was formed from TS/Ph 6, the northern end member and TS/Ph 7 which is located at the mouth of Taylor River that feeds into Little Madeira Bay (Figure 2). A total of 13 sample sites, 6 ponds and 7 creeks, were analyzed for water quality for the duration of dry season (Nov. 2004 - July 2005). In addition, triplicate floc cores were taken from each of the 6 ponds and analyzed for total phosphorous, nitrogen and carbon.

We hypothesize that the P concentration spikes observed during these months is a result of internal benthic process and longer water residence times occurring in the river rather than P input from Florida Bay.

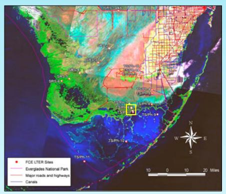


Figure 1. Landsat image of Taylor Slough highlighting LTER water quality monitoring stations.

Figure 3.Aerial photograph of lower Taylor River.

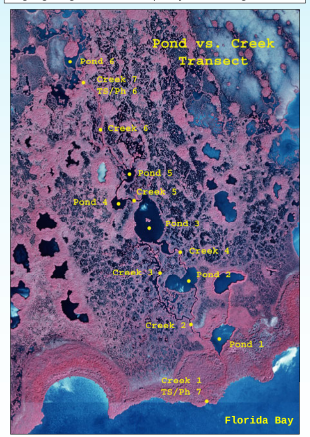


Figure 2. Landsat Image of Taylor River detailing collection points.

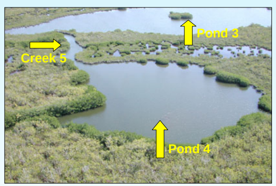


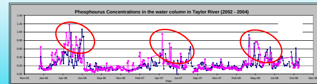
Figure 4. Aerial photograph of middle Taylor River.

Study Area

- ➢Study area is a 3 km transect of Taylor River. This system is characterized by interconnected creeks and shallow (<1.5 m) ponds.
- ➢Located in north-eastern Florida Bay, Taylor River feeds directly into Little Madeira Bay (Figure 1).
- ➢13 collection points were chosen of which there are 7 creeks and 6 ponds (Figure 2).
- ➢Distinct wet (June – Nov.) / dry (Dec. – May) season with a micro-tidal range of <0.05m
- ➢Dwarf mangrove forest (1-2m canopy)
- ➢Highly **oligotrophic** system – P limited

Central Question

➢Phosphorus concentrations spike in the water column throughout the onset of dry season and decrease with the return of freshwater flow from the north.



➢But where is the phosphorus coming from?

Hypothesis

➢**Hypothesis 1** – Water column P concentrations are coming from internal benthic sources rather than Florida Bay input and will be significantly higher in Ponds than in Creeks.

➢**Hypothesis 2** – Phosphorus concentration spikes are a result of longer water residence times coupled with the accumulation and decomposition of the floc layer in the ponds.

Methods

Figure 5. Sarah Ridgway collecting at site Creek 4.

Water Quality:

- ➢Grab samples taken monthly from each of the 13 collection sites.
- ➢Analyzed for TN, TP, TOC, and filtered samples for NO_3, NO_2, NH_4, SRP, AND DOC.

Floc Samples:

- ➢Triplicate 2.5 cm cores taken monthly from each of the ponds.
- ➢Floc height measured and recorded.
- ➢Sample was dried at 70° for 72 hours and weighed for gdw..
- ➢Samples analyzed for total phosphorus, nitrogen and carbon.

Figure 6. Excess water decanted from core.

Figure 7. Floc height recorded in cm.

Results

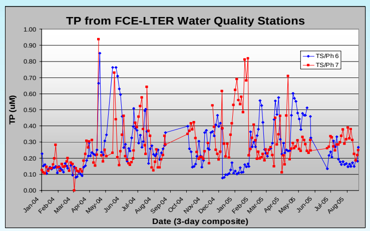


Table 1. Phosphorus spikes did occur during the dry seasons in 2004 and 2005.

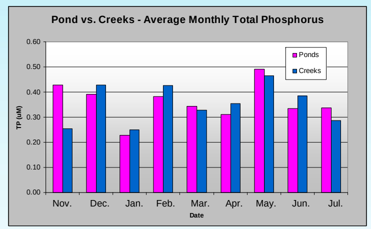


Table 2. There appears to be no significant differences between Ponds and Creeks.

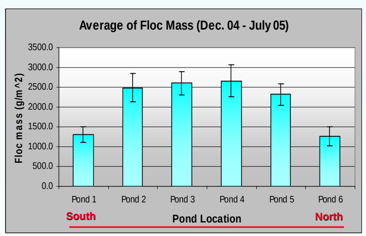


Table 3. Average floc Mass. Note the significant difference in middle ponds.

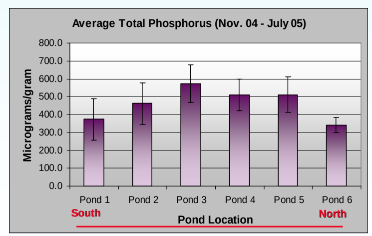


Table 4. Average floc TP. Large standard error in Pond 1 result of unknown event in Apr. 05.

Results cont.

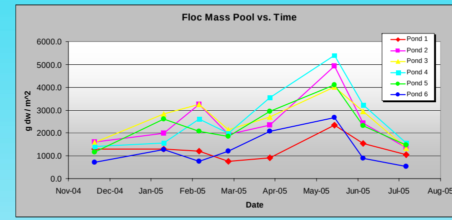


Table 5. Note the relatively small change in mass Ponds 1 and 6. Floc mass at all ponds decreased dramatically at the re-introduction of the "flushing" freshwater flow that began in Jun.05.

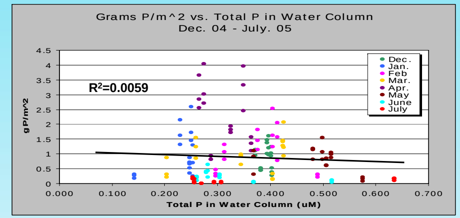


Table 6. While there appears to be no relationship overall, individual months demonstrate distinctive groupings. These groupings have a wide variation of trends.

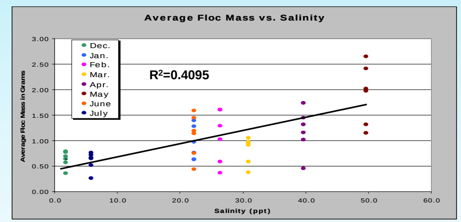


Table 7. Floc Mass shows a positive relationship with salinity, a prime indicator of physical influence from hydrologic drivers. As freshwater flow decreases, salinity and the accumulation of floc increases.

Discussion

While there was no significant differences in water column TP between ponds and creeks, P spikes are being recorded at the FCE-LTER WQ monitoring sites.

It appears that floc mass is closely related to the reduction of freshwater flow and the longer water residence times exhibited by a gradual salinity increase. Due to the relatively small changes in mass at Ponds 1 & 6 throughout the dry season, the source of the floc seems to be coming from internal sources, rather than from Florida Bay (Table ?????). Most likely, the decomposition of mangrove leaves and other submerged aquatic vegetation contributes to this feature.

So is there a relationship between TP in the floc layer and TP in the water column? Current data resists this idea. However concentrations of several other organic and inorganic nutrients will aid in profiling nutrient dynamics in this salt/freshwater interface.

Acknowledgements

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All major data anomalies will be attributed to trans-Atlantic African dust clouds.